

# Australian contribution to ILWS

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Sydney



# Summary of Australian Interests

- Space weather and service delivery
- Space weather monitoring in real-time
- Space weather data in real time
- Realistic models of magnetosphere, ionosphere and solar wind interaction
- Recognition of imminent solar activity



# Australian Contributions

- Solar
- Magnetospheric
- Ionospheric
- Space weather prediction
- Southern hemisphere sites for satellite data downloads or ground-based monitoring

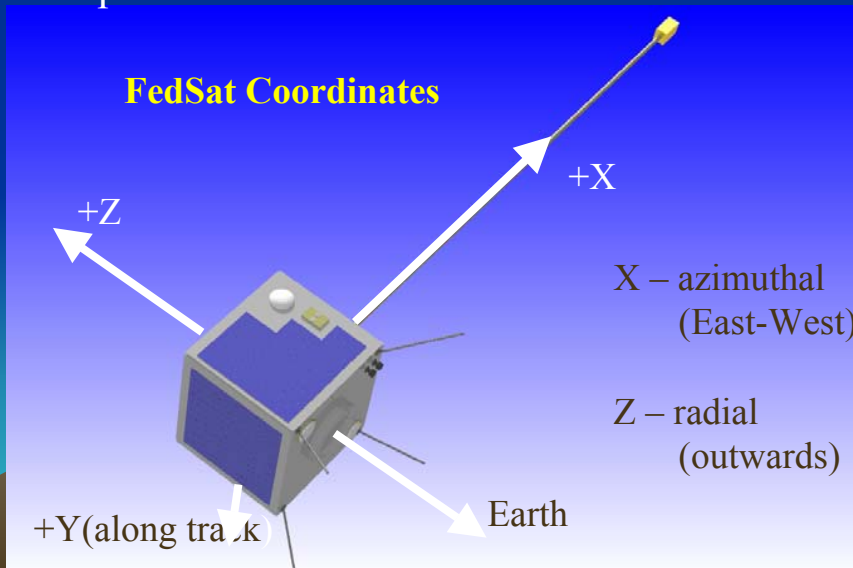


# Fedsat – An Australian Research Satellite

- Australia's first satellite in 35 years
- Built by Cooperative Research Centre for Satellite Systems (CRCSS)
- 58kg micro satellite (approx 50cm cube), three-axis stabilised and with 2.5m deployable boom
- Scientific and communications experiments (UHF, Ka band, GPS, magnetometer)
- Launched by NASDA in H-IIA rocket in December 2002
- In a low Earth circular polar orbit, sun synchronous at 10:30 LT, an inclination of  $98.7^\circ$  and a period of  $\sim 101$  min



**Above:** Launch of the NASDA H-IIA rocket carrying Fedsat into orbit, 14 December, 2002.

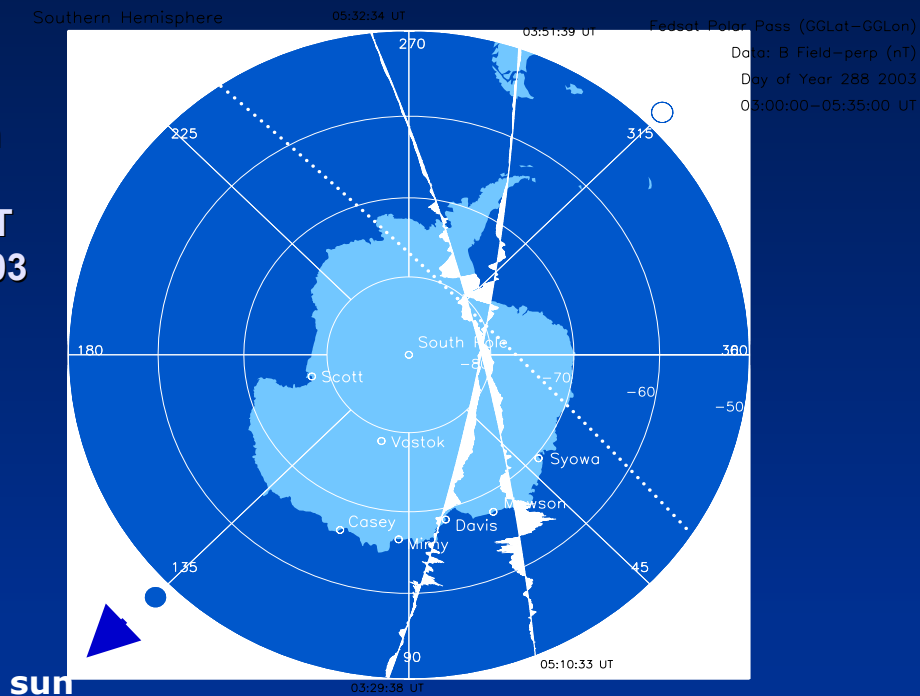


## Newmag magnetometer payload

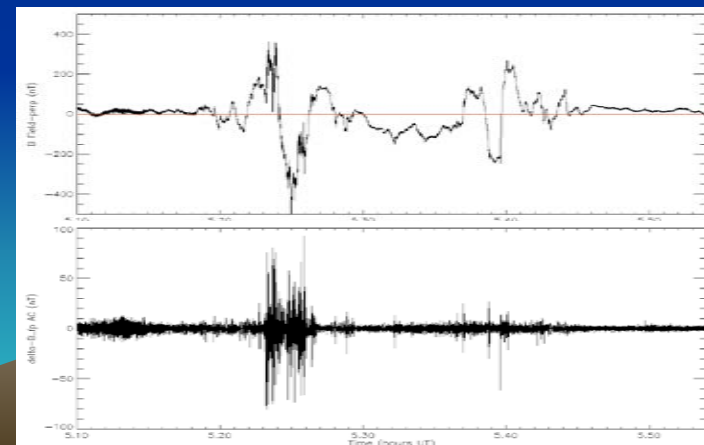
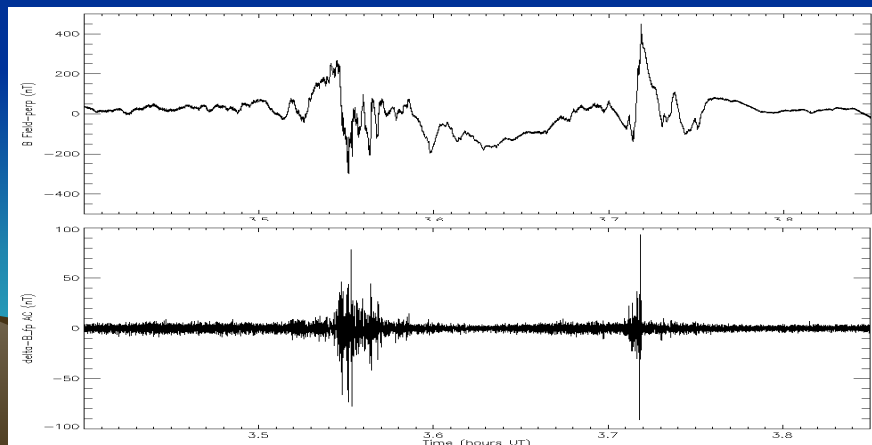
- Triaxial fluxgate magnetometer
- Built in collaboration with IGPP/UCLA
- Mounted on 2.5m boom to minimise interference from the spacecraft platform and other payloads
- Burst mode sampling rate of 100 vector samples/second (nominally 10VS/s)

# Newmag – 100Hz triaxial fluxgate magnetometer

**Fedsat South  
polar pass  
0320 - 0535 UT  
15 October 2003**



Plot generated Fri Feb 13 2004

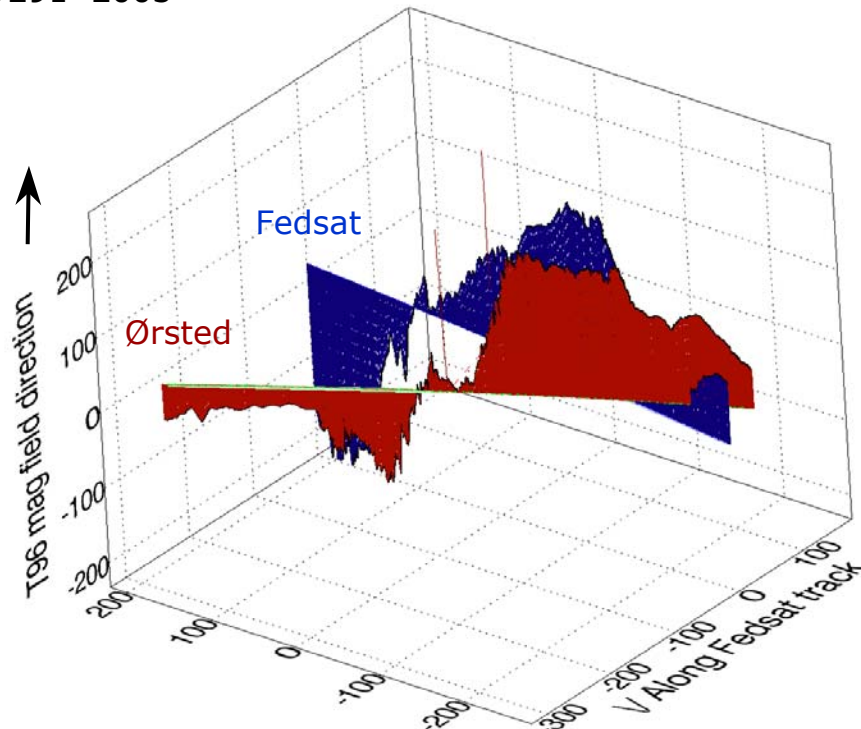


# Fedsat – Ørsted conjunctions:

detail of large-scale FAC at conjunction ( $\pm 200\text{km}$ )

## Conjunction 1

D291 2003

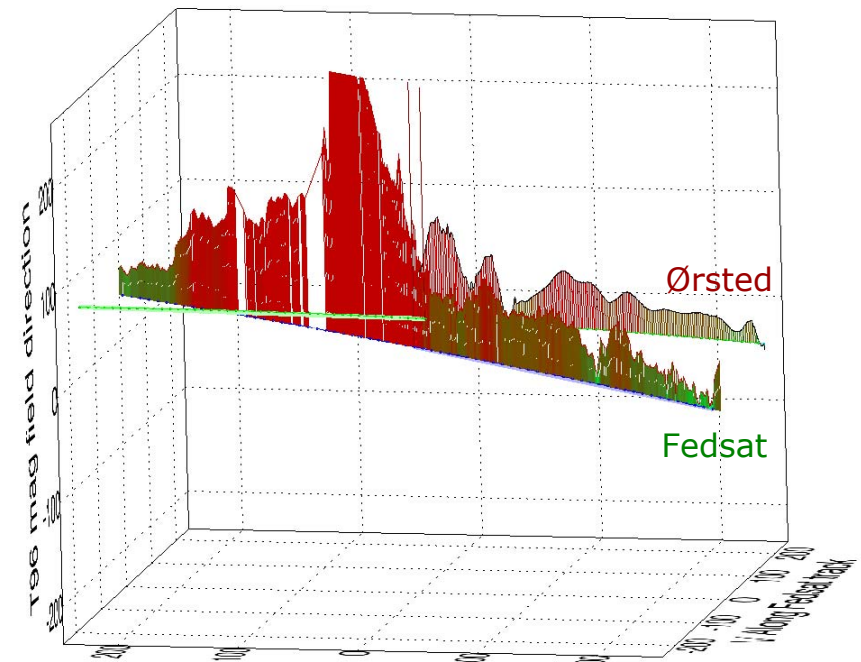


All distances in km from point of closest approach

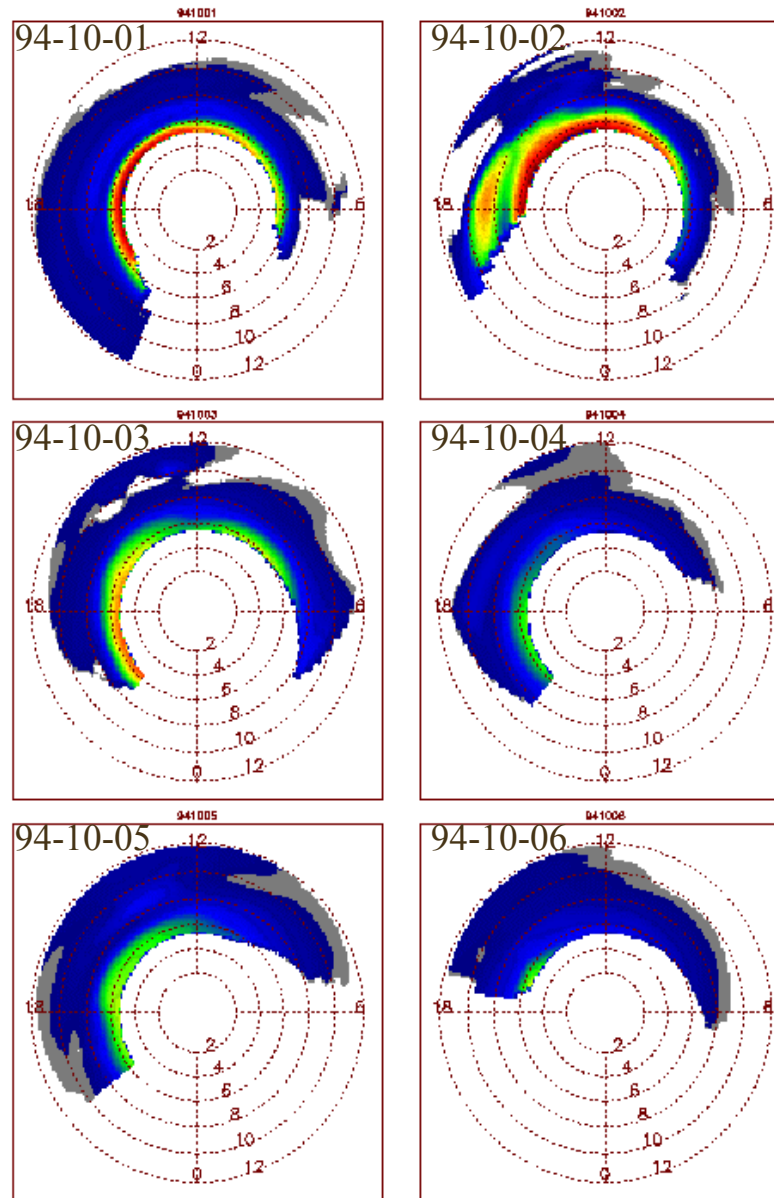
- $\Delta B_{\text{perp}}$  plotted along satellite tracks

## Conjunction 2

D314 2003



# Ground Magnetometers



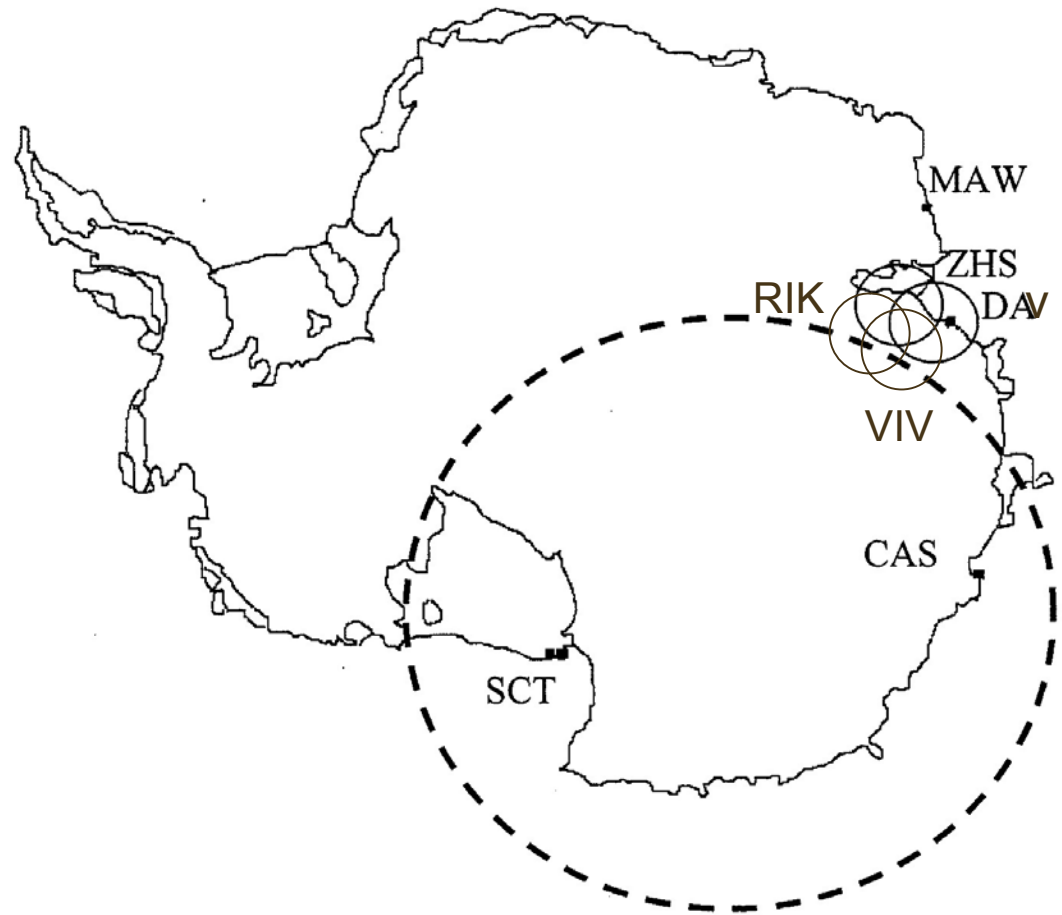
- Canopus data
- Latitude chain
- Cross-phase
- FLR inversion

Plasma Mass Density

Waters, 1998

## MAGNETOMETER SITES IN ANTARCTICA

- Wide-spaced arrays
- Close-spaced arrays



Also Macquarie Island  $L \sim 4$

# TIGER



## TIGER

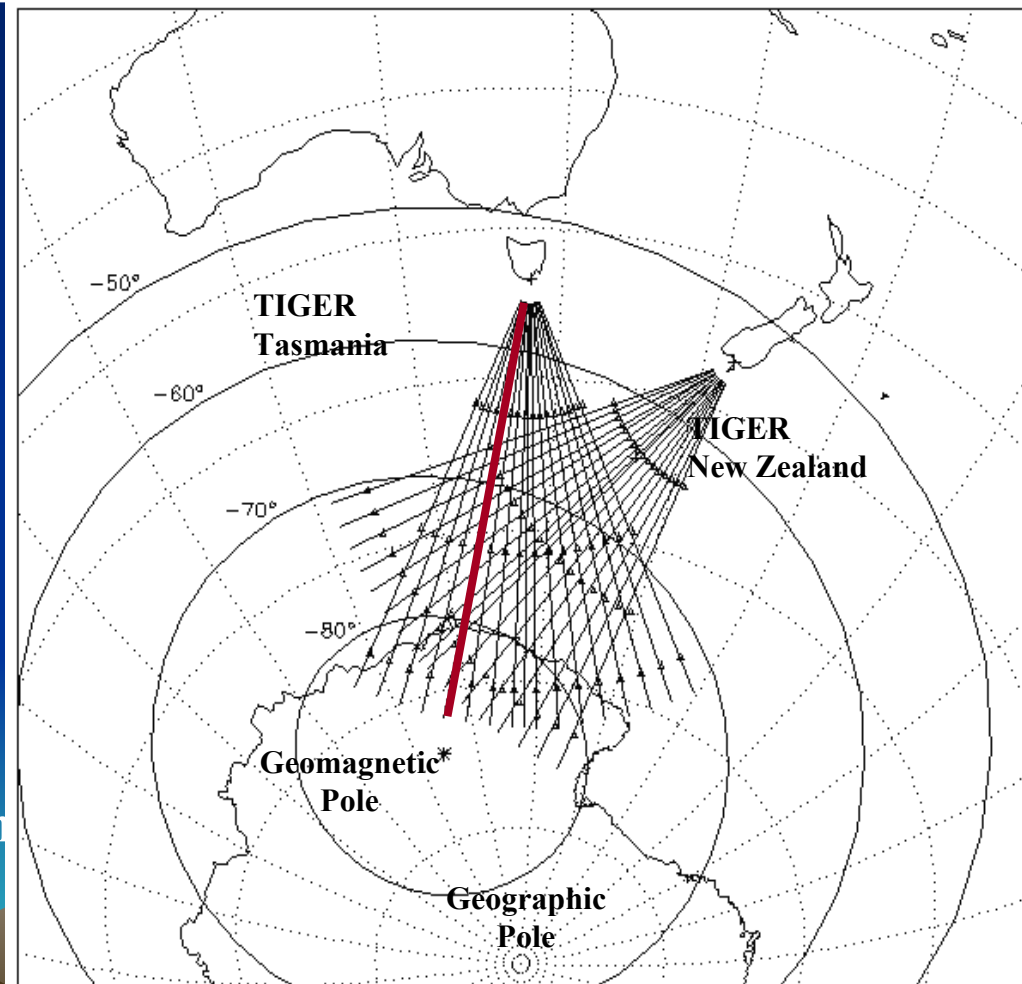
(Tasman International Geospace Environment Radar)

### Concept:

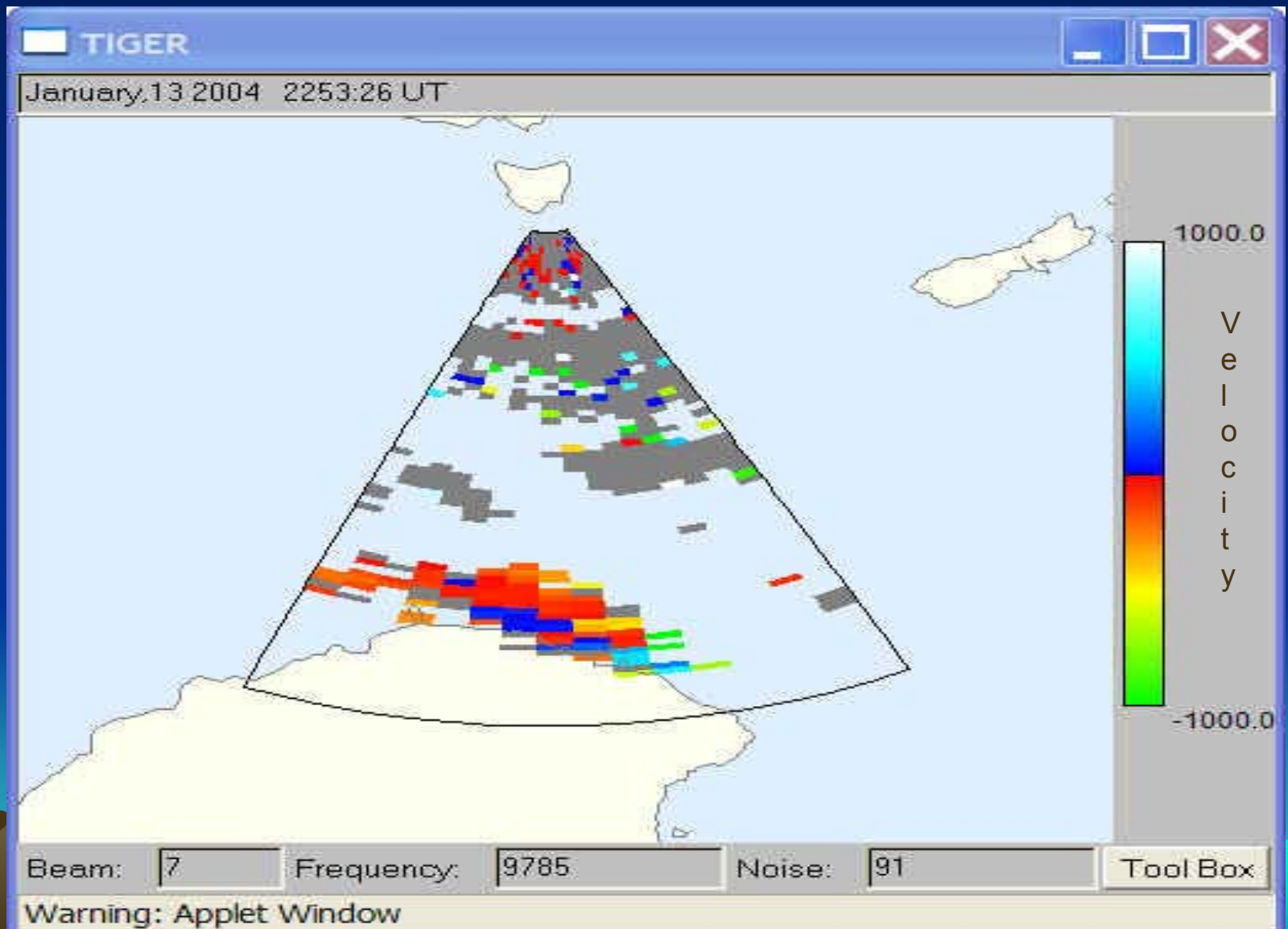
2 radars with intersecting beams.

### Advantages:

- Lower latitude coverage than other SuperDARN radars
- Provides essential longitude coverage for mapping convection in Southern Hemisphere



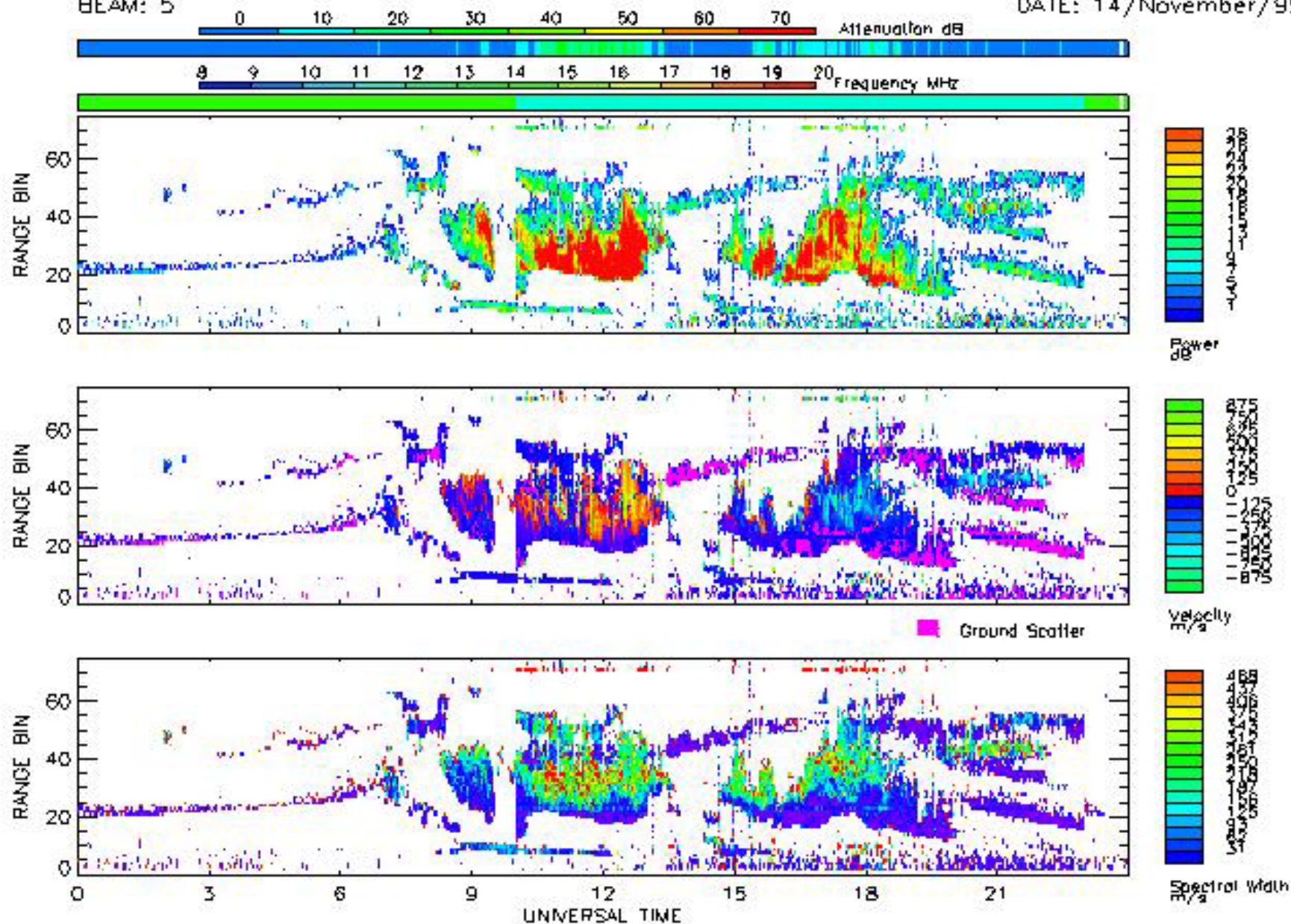
# TIGER Real-time snapshot



# Tasmania RANGE-TIME-PARAMETER PLOT

BEAM: 5

DATE: 14/November/99



# COSRAY Program

## Equipment

- Multi-directional surface and underground muon telescopes (Mawson, 73 S mag and Hobart, 51.6° S mag)
- Collaborative array with Japan, Brazil, Germany monitoring space environment variations

## Scientific Program

- Magnetic storm precursor identification
- CME shock strength and geometry via collaborating high and low energy monitor arrays

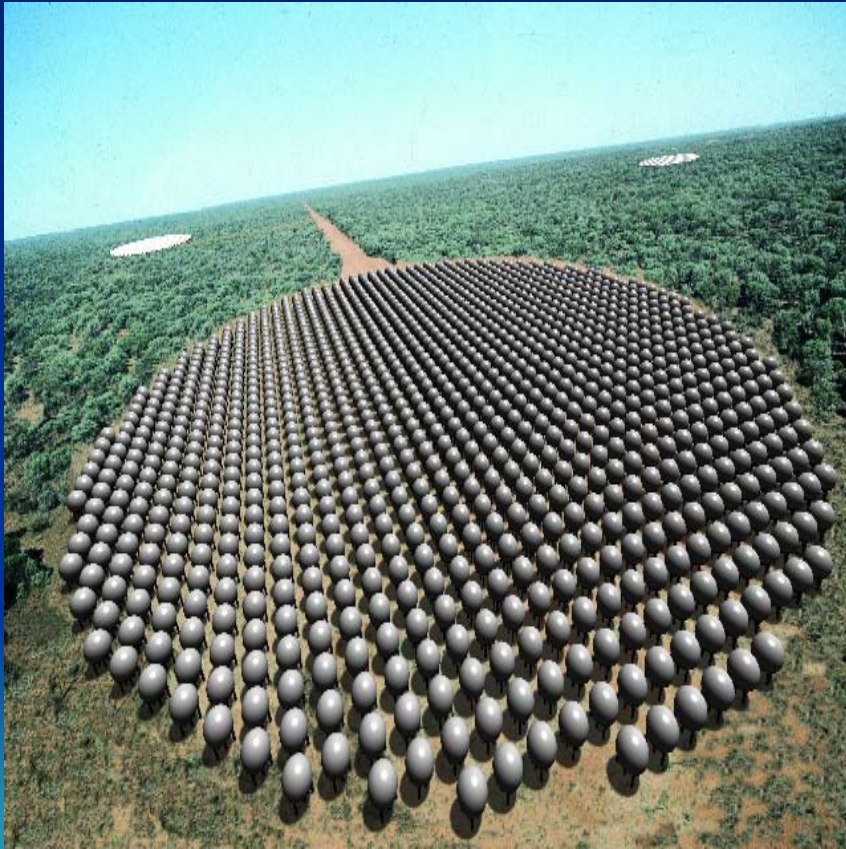


# Earth Station Downlink Availability

- Aust. Remote Sensing Centre (ACRES) Alice Springs (9m X/S-, 5m X-band dishes)
- TERSS (9m X-band Landsat 7) Hobart
- FEDSAT, Adelaide (3m Ka-band dish)
- IMAGE (commencing soon)

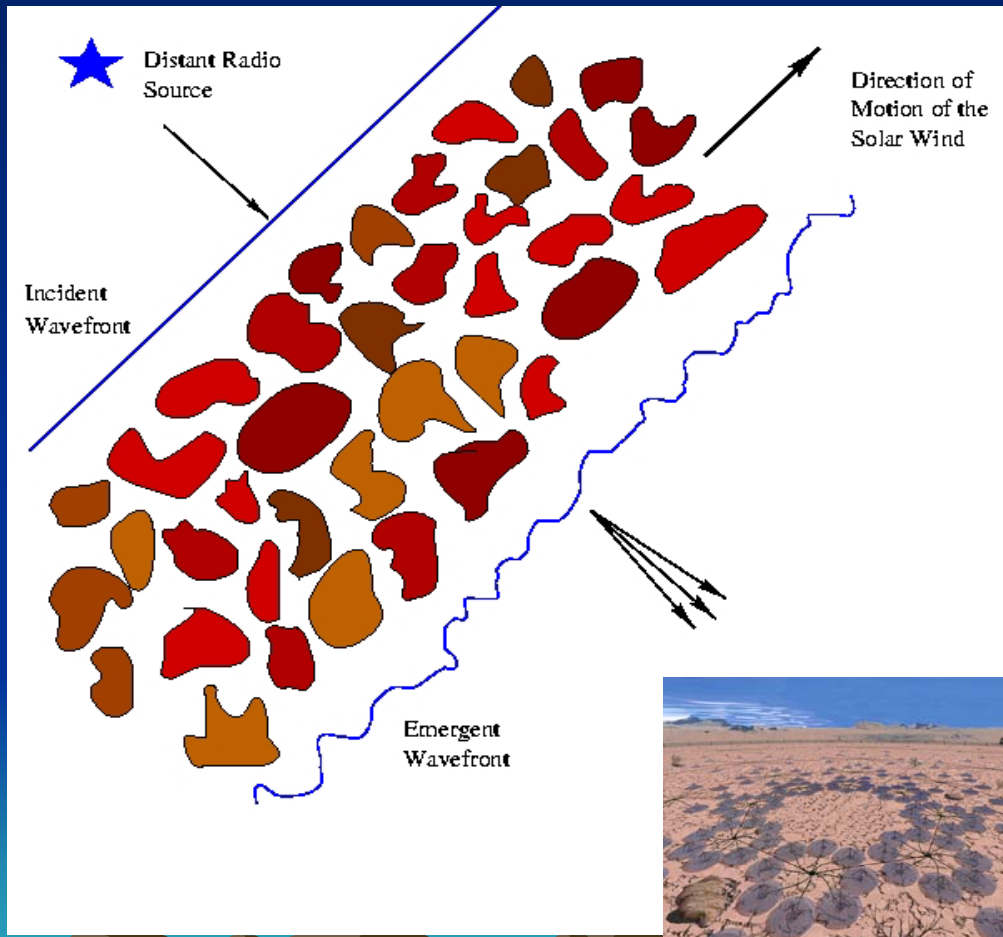


# Monitoring antenna arrays



- Radioastronomy arrays in HF-VHF (LOFAR/IRQUA) and higher frequencies (Square kilometre array) show possible options for monitoring

# Inter-Planetary Scintillations



- Plane wavefront incident from a distant compact source
- The density fluctuations in the Solar Wind act like a medium with fluctuating refractive index, leading to corrugations in the emerging wavefront
- These phase fluctuations develop into intensity fluctuations by the time they reach the observer
- The resulting interference pattern sweeps past the telescope, leading to IPS

# Scientific Programs

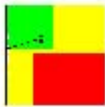
- Space Weather
  - Ionospheric prediction
  - Ionospheric modelling via multi-satellite data
  - Magnetospheric modelling
  - Polar/Auroral current modelling
  - Solar flare prediction
  - Far side solar holography
  - Data fusion recognition of solar active regions



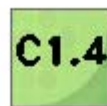
# IPS Space Weather Status Panel

## Solar Conditions

Solar Wind  
Speed



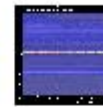
X-Ray Flux



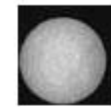
X-Ray Flares



Latest Culgoora  
Spectrograph



Latest Culgoora  
H-Alpha Image



## Geophysical Conditions

Geomagnetic  
Warning



K-Index



pc3 Index



GEOSTAT  
Alert



Geomagnetic  
Alert



Aurora  
Alert



## HF Propagation Conditions

HF Comm. Warning



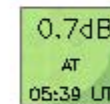
Current HF Fadeout



HF Fadeout Warning

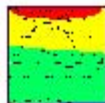


Polar Cap Absorption

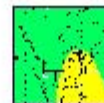


## Ionospheric Conditions

Australasia



North America



Europe



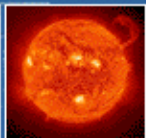
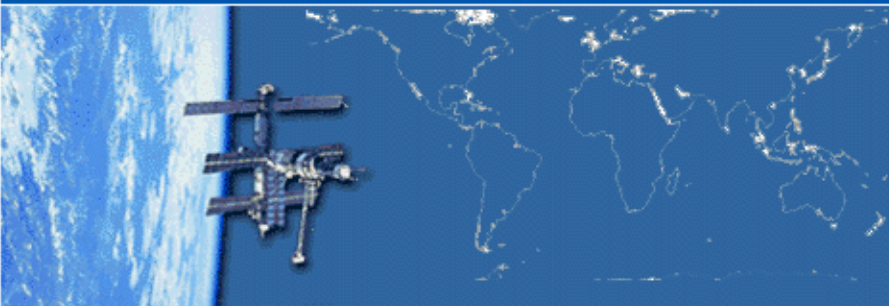
# www.ips.gov.au



The Australian Space Weather Agency

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## Site News

- [29/05/02: New IPS Website](#)
- [17/04/02: Solar Eclipse over Australia](#)
- [20/02/02: New Educational Material Available](#)
- [17/12/01: The Leonid Meteor Storm of 2001](#)

[\[more\]](#)

## IPS Hosted Groups

[Australian Radiocommunication Study Group 3](#)

[Ionosonde Network Advisory Group](#)

[National Committee for Radio Science](#)

[Solar Terrestrial and Space Physics](#)

[Space Physics Interactive Data Resource](#)

## Acknowledgments

IPS is a unit of the [Department of Industry, Tourism and Resources](#)

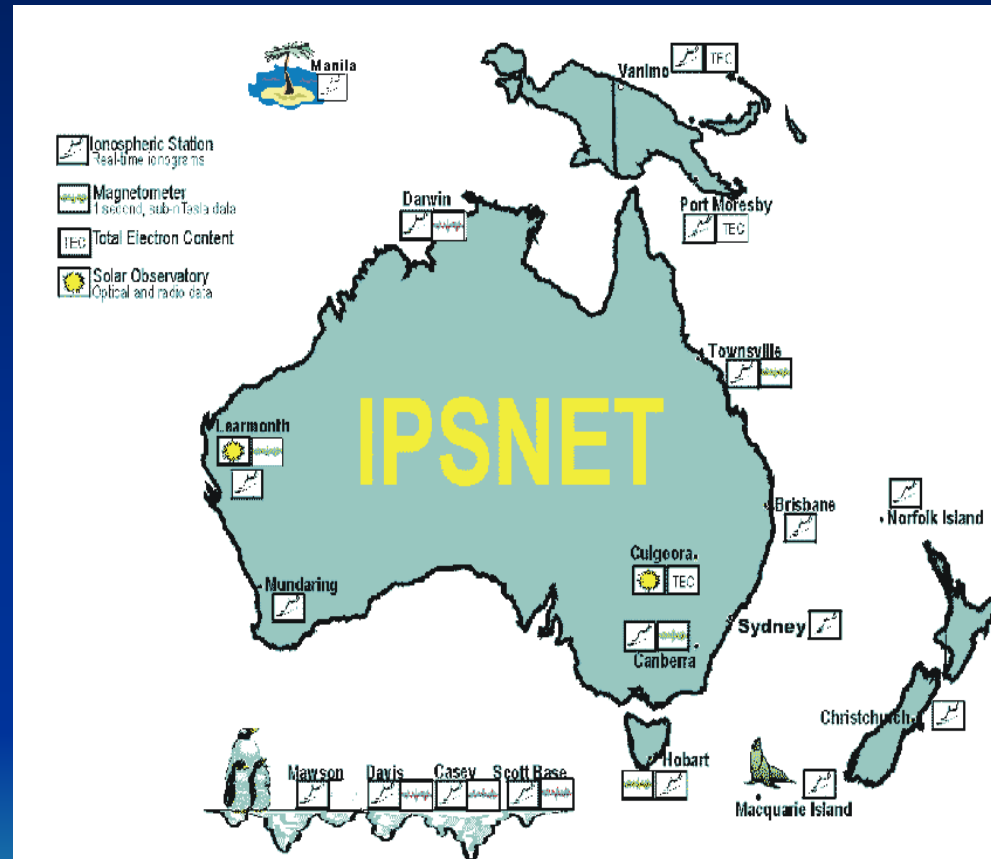
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# Aust Monitoring network

- Network of sites
  - Australian mainland
  - Antarctic Territory
  - PNG and Pacific (Norfolk Is., and Niue)
  - New Zealand
- Low-High latitudes
- 150E long. chain
- Area covered (110E-170W, 0-70S geog.)



# WDC for Solar-Terrestrial Science

- Solar data (real-time radio spectrograph, optical patrol)
- Ionospheric data (real-time ionosonde data)
- Geomagnetic data (real-time variometer, Fedsat 3-component magnetometer)
- Cosray data
- High latitude data (south polar latitudes, TIGER auroral radar)
- Low latitude data



# Current Australian ionospheric sites

Site	Lat	Long	GLat
<u><a href="#">Vanimu</a></u>	2.70	141.30	12.6
<u><a href="#">Port Moresby</a></u>	9.4	147.1	18.6
<u><a href="#">Darwin</a></u>	12.45	130.95	23.2
<u><a href="#">Townsville</a></u>	19.63	146.85	28.4
<u><a href="#">Brisbane</a></u>	27.53	152.92	35.7
<u><a href="#">Norfolk Island</a></u>	29.03	167.97	34.8
<u><a href="#">Mundaring</a></u>	31.98	116.22	43.5
<u><a href="#">Camden</a></u>	34.05	150.67	42.5
<u><a href="#">Canberra</a></u>	35.32	149.0	44.0
<u><a href="#">Hobart</a></u>	42.92	147.32	51.6
<u><a href="#">Macquarie Island</a></u>	54.5	159.0	61.6
<u><a href="#">Casey</a></u>	66.3	110.5	77.8
<u><a href="#">Mawson</a></u>	67.60	62.88	73.0
<u><a href="#">Davis</a></u>	68.58	77.96	76.6

# Australian Space Weather Plan

- **Space weather monitoring & services**
  - **Establishment of space weather agency**
- **Space weather research priorities**
  - **Research community to agree priorities**
- **Community outreach**
  - **Education and enhancement of infrastructure design and planning**

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